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This report includes a study of the need for marine technicians in California, implications for the national scene, and observations made at a national conference held in Florida in 1968. Problems treated are (1) definition of a marine technician, (2) how marine technicians should be classified, (3) how great is the demand for them, (4) the type of work they do, (5) what skills and training they need, (6) their pay scale, (7) women as marine technicians, (8) how a junior college educates and trains marine technicians, (9) which junior colleges are already doing so, (10) the amount of financial support for this program, and (11) the type of evaluation program that should be set up. General points and recommendations are: (1) marine technology involves marine oil and mining, aquaculture, oceanography, fisheries technology, research and hardware, (2) civil service organizations should establish classifications and pay scales for marine technicians, (3) demand for marine technicians in the next five years will be about 38,000, (4) at least 20 junior colleges in America will be involved with marine technology by the early 1970's (half of them in California), (5) financing the programs is very difficult, and (6) in establishing a program, communities should inspect carefully the demand for marine technicians, community attitudes, proximity of marine facilities, ability to finance, and availability of experienced staff. (RM)

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THE EDUCATION AND TRAINING OF MARINE TECHNICIANS

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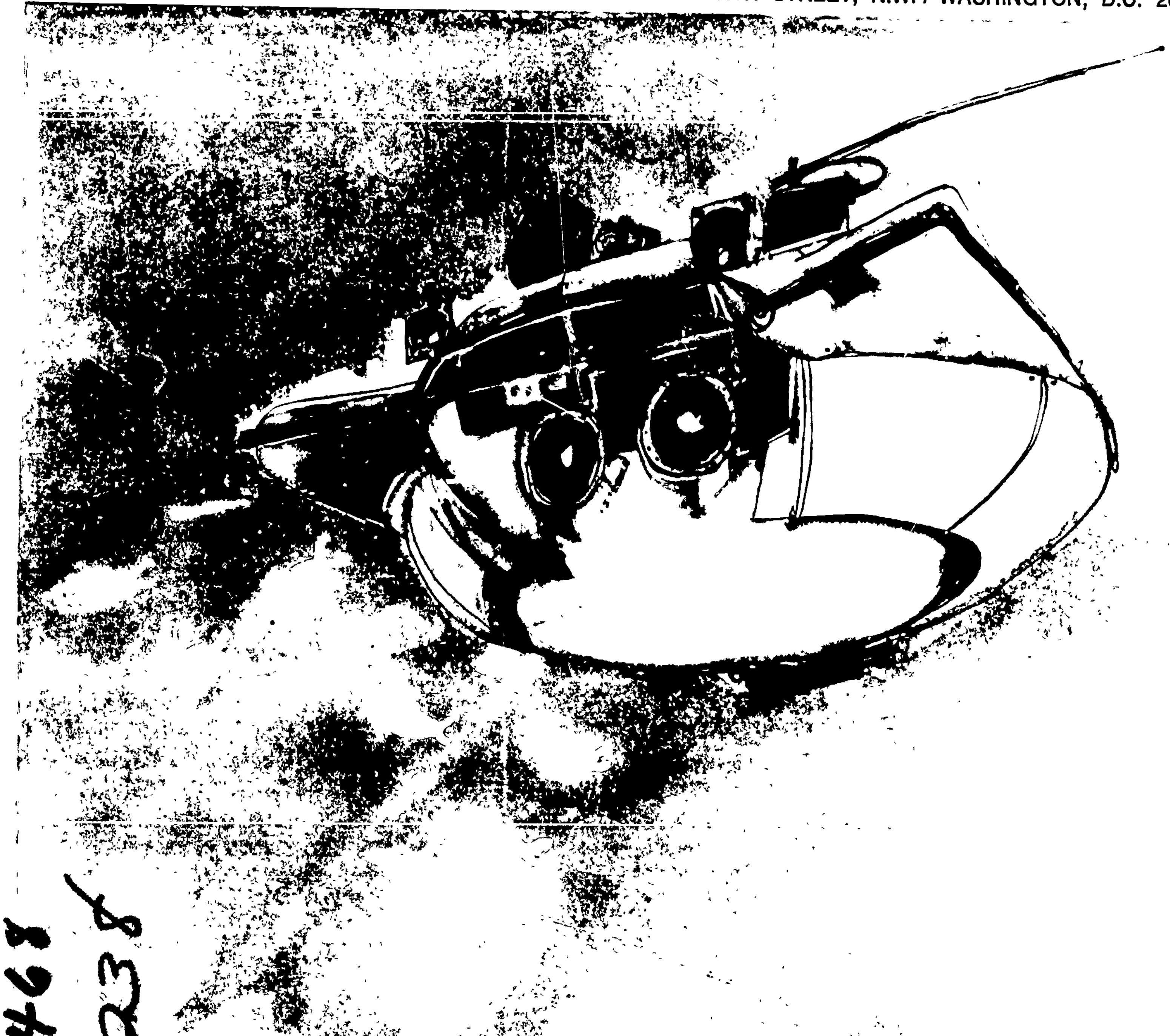

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Preface

Under a grant from the National Sea Grant Program of the National Science Foundation, the American Association of Junior Colleges held an invitational conference in St. Petersburg, Florida, March 17-20, 1968. The purpose of the conference was to investigate the capabilities of the two-year community junior college in promoting marine resource development by training marine technicians. (The program of the conference and the attendance list are attached as Appendix II and III, respectively.)

The conference not only provoked a great deal of discussion and controversy, but also uncovered much interest in the development of marine technology programs in two-year colleges. Need for further dialogue became apparent, to better define marine technology as an occupation and to provide guidelines for colleges establishing programs.

Gordon Chan of the College of Marin, Kentfield, California, was an active participant in the St. Petersburg conference. He, also, had completed a study under the aegis of the Bureau of Vocational-Technical Education of the California Community Colleges on the need for marine technicians in California. It was felt that the distribution of Mr. Chan's study, augmented by the discussions held in St. Petersburg would be of value.

That has been done in this publication. What follows is essentially the "California Study" with expanded implications for the national scene and appropriate observations made at the St. Petersburg conference.

Comments on Mr. Chan's manuscript were solicited from a small group of knowledgeable and interested persons (see Appendix IV) and many of their reactions were incorporated into this publication.

Much more remains to be done; but, for the present, it has been established that there is a substantial need for persons trained in marine technology, and that the two-year college can play an important role in this training.

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Introduction

Until quite recently, the general public has not been aware of the needs of technician education. The technical education role was assumed by a small number of public and private schools. In public junior colleges, technical education has been overshadowed by the dominance of transfer programs. Often, educators of transfer programs generally do not look favorably at technical education programs.

Technician education programs have mushroomed in size, number, and variety to keep pace with the demands of increasingly sophisticated occupational patterns. This growth in technology is mirrored in the vast interest to exploit the oceans. Thus, the emerging technology has blossomed forth with new materials, new processes, electronic automation, and improved techniques of measurement and control. All this expansion of knowledge has increased the need for technically competent technicians with special abilities who can support and supplement the efforts of professional engineers and scientists involved with marine activities.

Although difficulty in technical standardization exists, this report is intended to serve as a sourcebook and to provide information, guidelines, and recommendations to governmental agencies, administrators, and other college personnel so that the marine technology program may be successful and of high quality. Moreover, industries and government agencies will find the report helpful in analyzing their indigenous marine interest. Toward this objective, the report provides background information to technical training, interpretation of marine technology education, occupational demand and salaries for technicians, and descriptions of marine technology programs throughout the nation. The major collection of data will concern California, with some statistical projections made for the United States as a whole.

Gordon L. Chan

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TABLE OF CONTENTS

COVER: A reproduction drawing of a deep submersible research vessel which was submerged to 8,310 feet on February 28, 1968. This vessel represents a fraction of the latest enlargement of ocean developments.

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PROBLEMS OF JUNIOR COLLEGE TECHNICAL EDUCATION

1

Junior colleges throughout the nation generally have comprehensive programs. Their curriculums lead their students to transfer or employment, and they have developed large-scale adult education programs. Today, junior college programs are fixed assets within each state, and within some states junior college programs are the dominant forms of higher education. An example of this is seen in California where the junior colleges enroll approximately 80 per cent of all fulltime freshmen and sophomores in California public higher educational institutions (10). Furthermore, California leads the nation in the number of public junior colleges (eighty-seven); and with the multiple population increase in the state, the junior college facilities and student enrollment will continue to mushroom. The growing pains of the junior colleges are surely not tranquil ones — besides the current turmoil of student unrest, the philosophical status problems of junior colleges continue to complicate the horizons.

The following discussions will highlight some of the major issues facing the junior colleges; the major purpose of pointing these out is to alert the reader to the problems of developing a curriculum in marine technology. The statements made are general and obviously do not apply to the exceptions.

What Type of Students Enroll at Junior Colleges?

The main enrollment of junior colleges comes from the middle and lower classes. It is estimated that only approximately 5 per cent of the enrollment in the typical community college comes from the upper and upper middle classes (10:42). Thus, 95 per cent of the student population is generally from the working classes. Approximately two-thirds of entering junior college students listed these reasons for attending (10:47): (1) persuasion by parents, counselors, and friends, (2) location of college (proximity), (3) lower cost.

Various sources of evidence make it clear that junior college freshmen as a group score somewhat lower on tests measuring academic aptitudes than do four-year college freshmen. Also, it was found that students enrolled in transfer programs score higher than students enrolled in occupational-terminal programs. However, studies indicate that roughly 30 per cent of the students entering junior college score above the mean of students entering four-year colleges (10:30-40). Thus, there is in the junior college a large segment of students who are capable of academic work as rigorous as that offered in other higher educational institutions.

What Is the Common Educational Goal or Aspiration of Junior College Students?

Nationally, it has been estimated that approximately 40 per cent of high school graduates attend college (21:86-95), and there is reason to expect at present that this will increase. Two-thirds of the entering students generally classified themselves as "transfer" students (with plans to go on to a four-year college). Statistics reveal that nationally only about one-third of the entering students later transfer to four-year colleges, and in reality, two-thirds end up with a "terminal" or "postponed" education. Students tend to enroll heavily in transfer courses because of cultural, parental, and pres-

ERIC

tige values attached to a baccalaureate program; students are frequently loath to admit, even to themselves, that they are not candidates for the bachelor's degree. The College of Marin in Kentfield, California, reports that about 30 per cent of its graduates go on to a four-year college, while 70 per cent do not, thus falling within the national pattern. While it is true that some of these "terminal" students enter occupational programs (nursing, electronics, etc.), the majority are dropouts from their original transfer intentions (although many return later to continue their education). To further complicate the situation a study indicated that approximately 19 per cent of all male students who completed two years of junior college were still undecided as to their educational and vocational plans (21:98). Clearly, then, the junior college has difficulties in effectively emphasizing occupational programs.

Medsker stated that of 243 reporting institutions, 86 per cent had occupational programs for students not expecting to transfer. Approximately 91 per cent offered a transfer program. In the Medsker interview with administrators, only a few reported students who were strictly "terminal" in their educational aspiration.

In summary, these are the general conclusions concerning junior college students as a group.

1. Junior college students are basically from the working classes.
2. Junior college students are less academically oriented than students entering four-year colleges, although about 30 per cent score higher in aptitude tests than the mean of students entering four-year colleges.
3. They are prone to consider themselves as transfer students and usually enroll in transfer courses.
4. Approximately one-third go on to a four-year college, many still not knowing their future occupational goal, and about two-thirds terminating their education at or before two years. It is from among this latter group that candidates for marine technology and similar programs will be drawn.
5. The junior college attrition rate is high. Only proper counseling in high school and college, and understanding of student motivation and cultural backgrounds can divert individuals to technology programs.
6. While the comprehensive junior college offers transfer and occupational programs, the former is by far the most popular program in our middle class cultural system.

INVOLVEMENT OF THE JUNIOR COLLEGE IN THE EDUCATION AND TRAINING OF MARINE TECHNICIANS

2

Broadly speaking, one can generally classify all college programs as vocational because some working classification is made after formal education. The education of marine technicians is but one vocation available to the masses of students who desire status in life and want a challenging job.

In previous decades, a job in the marine sciences was a rare opportunity. Even today, to be an oceanographer of Jacques-Yves Cousteau fame is an unrealistic goal for the average student. Yet countless numbers of school children are entranced with the idea of this type of professional occupation. How often does an educator hear in a counseling situation: "I want to be a marine biologist or an oceanographer"? Young proteges realize all too late that only the gifted, small percentages of the top students really achieve the vocational goal of the oceanographer as ideally depicted.

Fortunately for most of us, there is plenty of room below the top, and it should be emphasized that all the component activities are necessary to the success of each constructive undertaking. The performance of a leader may indeed be brilliant, but even so he is but one individual, and most of our projects are supported by many individuals.

A new realism has been interjected into the marine employment picture — the education and training of marine technicians. This program is conducted on a technician level and not a professional (B.A. degree) level. Care must be given in counseling students to ensure that they understand the implications of the program in which they enroll.

Captain Thurman K. Treadwell, Jr., Commander of the Naval Oceangraphic Office and current president of the American Society for Oceanographers, while attending the American Association of Junior Colleges conference on marine technology in Florida, March 1968, issued this challenge to the American junior colleges:

> Your task is getting young people to work as technicians — a vocation which they consider now to be a second-rate thing. I think this is one of the main problems that educators face . . . I think and hope you can.

This experienced scientist has clearly portrayed the mammoth task of the role of the junior college in training any type of technician in the light of our middle class culture.

Captain Treadwell also reviewed the need for junior colleges to train marine technicians. Since he commands a fleet of about nineteen oceanographic survey ships, he, like most employers of marine technicians, hires individuals trained to support the professional researchers. In the AAJC Florida meeting, Captain Treadwell, whose organization probably employs the greatest number of marine-oceanograpic technicians, resounded the call to train marine technicians:

> Speaking for my office, I'll need 100-200 marine technicians a year within the next five years. If I can find them, fine. If we can't find them, then we will have to continue with our present system which involves putting our professionals (B.A. degree and up) to *work* on this sort of task!

The advancement of productivity in our nation depends much on the skills of all of her industrial population — working and developing its talents in line with their educational background. Junior colleges have long seen their technical role in education: to train individuals to support the professional worker so that the latter may use all his wisdom and training to further the advancement of man.

Some of the problems and questions facing the American junior colleges in the training of marine technicians are:

1. What is a marine technician?
2. How should marine technicians be classified?
3. How great is the demand for marine technicians?
4. What type of work do they do?
5. What skills and training do they need?
6. What is their pay scale?
7. Do women work as marine technicians?
8. How does a junior college educate and train marine technicians?
9. What junior colleges are already involved in training marine technicians?
10. Is there financial support for this type of program?
11. What type of evaluation program should be set up?

Although this report will answer these questions, these problems have already been studied by a number of junior colleges throughout the United States. A report of the activities of these junior colleges which have, by and large, developed programs or are about to embark on programs to train marine technicians will appear later in this report.

WHAT IS A MARINE TECHNICIAN? 3

In the AAJC Florida meeting on marine technology, this question, "What is a marine technician?" attracted a mountainous number of responses. The general tone of the discussion defined a marine technician as either (a) a "sea-going man" or (b) a "sea or land man." However, before going into the arguments for either side, we will first define a technician to establish some common grounds.

Basically, five general abilities are considered to be universal requirements for a person in any technical occupation (23):

1. Facility with mathematics; ability to use algebra and some trigonometry as tools in the development of ideas that make use of scientific and engineering principles

2. Proficiency in the application of physical science principles, including the basic concepts and laws of physics and chemistry that pertain to the individual's field of technology

3. An understanding of the materials and processes commonly used in the technology

4. An extensive knowledge of a field of specialization with an understanding of the engineering and scientific activities that distinguish the technology of the field. The degree of competency and the depth of understanding should be sufficient to enable the individual to do such work as detailed design using established design procedures

5. Communication skills that include the ability to interpret, analyze, and transmit facts and ideas graphically, orally, and in writing.

If we assume that the above qualities generally describe a technician and that his work and training dictate his title, then we may proceed to define a marine technician.

Under the broadest definition, a *marine technician* is one whose education and experience qualify him to work in the area of marine technology employing the technical knowledge, methods, and skills listed above. If the term *marine technician* is restricted to the occupational range between the baccalaureate (B.A.) professional and the craftsman, considerable future confusion can be avoided. He may be employed directly as a sea-going or ocean technician aboard ship or as a technician only partly involved in marine activities. For example, the latter might be an electronic technician who might spend a portion of his occupation in marine activities; he would be titled *marine technician*. In the final analysis, the employer will determine whether an individual is classified as a marine technician or as an electronic technician.

Trying to classify a marine technician (sea vs. land-locked technicians) is like trying to define an "oceanographer." A geologist who graduates from a midwestern university and spends a portion of his time at sea may soon adopt the title of oceanographer for himself for reasons of self-esteem or job classification — this should be within his rights. Another individual who has graduated from a coastal university school of oceanography might take issue with this geologist, since oceanographers can "only come from schools of oceanography and must work full time at sea." The junior college intent is not to argue over definitions, but to educate and train individuals to fulfill a wide variety of employment opportunities. What is more vitally needed is clarity on employment classification and pay scales.

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Thus, "marine technician" is a broad term describing individuals in the occupational field of marine activities. Certainly, technical persons going to sea might be called oceanographic technicians (to avoid semantic confusion)—this would be a subset under marine technician. Likewise, in today's complex marine field development, there may be other subsets of marine technicians deployed in industry who never go to sea: e.g., landlocked technicians involved with marine activities. The California survey indicated many occupational fields in which marine technicians may perform:

> *engineering, offshore petroleum construction, offshore mining, undersea missions, desalination and water purification, shipbuilding, etc.*

On a broad basis the field of marine technology can be subdivided as follows:

1. Oceanography
2. Marine oil exploitation and mining
3. Scientific research in marine-related biology, chemistry, pharmacology
4. Fisheries technology
5. Hardware technology (electronic, mechanical)
6. Aquaculture
7. Natural products extraction
8. Aquarium management
9. Seafood processing.

All these individuals may be called marine technicians because of their job requirements and training.

In only a small percentage of technician jobs in marine-related activities actual ability to operate effectively under marine conditions approaches in importance the other factors necessary in the making of a good technician. Thus a good electronic technician, chemical technician, or biological technician can be a real asset in marine-related work; of course, the more knowledgeable one is about the conditions and requirements imposed by the marine environment, the more useful he will be.

Although the marine technician, per se, may be a jack-of-all-trades, it seems reasonable that as marine activity increases and the number of technicians required for a project grows, it will be found profitable to use teams of technicians, each of which brings specific (and different) capabilities to the job. In spite of this, it is worthwhile to make them as versatile and interchangeable as possible.

HOW SHOULD MARINE TECHNICIANS BE CLASSIFIED? 4

The Status and Classification of Technicians in General

Throughout the United States, marine technicians are being hired under many individual job classifications. There is no uniform classification of job requirements nor pay scale. At the AAJC Florida conference on marine technology, James E. Sykes, laboratory director, and Evert J. Brakke, regional personnel officer of the Bureau of Commercial Fisheries, St. Petersburg, Florida, stated the sociological and economical implications of the need for realistic technician classification in the following:

> In days gone by, too few people have taken pride in being technicians and members of a good scientific team. One of the principal causes has been that the technician, often not very well trained, is taken onto the staff at the GS-4 ($5,000) level, works on for years at that level, and knows that if he continues until retirement he will probably achieve the GS-5 level. There has been little incentive for potential technicians to train themselves with the thought of a good livelihood in mind. In government we are living under a system which entitles certain technicians to advance to GS-11 or 12 ($12,500) but the percentage of them doing so is unusually small. We must face the fact that we live with rather strict limitations gradewise and salarywise for the nonscientist; therefore, we are not recruiting the best people. Only when we *raise* the technician series in quality will alert people eagerly take the marine technician's course in the junior college . . . If we train these candidates properly to begin with and establish a good system for them to enter, then we might overcome a great many of the technical and emotional problems which we currently undergo.

Although these words were chiefly directed toward the program in marine technology, one can be sure that the authors also meant them for all technologies. The technical education programs of junior colleges and technology schools are doing a good job in fulfilling community employment needs. However, technical training, by competing against transfer programs, has become a second choice for the average college student, and the addition of new technology programs does not usually offer any improvement in the status of the technician. In the light of national interest in marine technology and the psychological instability of the current college student, the time may be ripe for creating more realistic bridges between technical and baccalaureate-level jobs.

Steps to Increase Marine Technician Status

As for technicians with about two years college education, there remains a lack of any national or even local movement to improve their lot. If the leaders of marine technology along with those of other technologies (i.e., engineering, chemical, etc.) could together stress the importance of technician skills in the nation's productivity and welfare, then possibly the struggle for technician status might be successful. Here are some suggestions to promote dialogue and action. The intent is to correct the means while providing the ends:

1. Most important, the United States Civil Service Commission should realistically develop a graduated scale of the skill classification of marine technicians with realistic wage scales comparable to those paid for similar positions in industry. The following classification scheme has been used in the *University of California Personnel Employment Manual,* and along with my additional comments, it is intended as an example for future action by governmental and private organizations involved with marine technology.

CATEGORIES	SUMMARY OF DUTIES
Marine Technicians: (Two years college education in marine technology; or an equivalent combination ᶜ education and experience)	At sea and ashore, assists in making observations and recording physical, chemical, and biological data; may have charge of scientific equipment and supplies of limited complexity and variety; and have other related duties as maintenance, distribution, etc.
Senior Marine Technician: (Two years college education in marine technology with four or more years in experiences related to the work to be performed; or four years education in marine technology; or an equivalent of education and experience)	At sea and ashore, assists with training of new personnel; directs and makes scientific observations; maintains, improves, and tests existing and new equipment; and performs other duties as required
Principal Marine Technician: (Two years college education in marine technology and ten years experience related to the work to be performed; or four years education in marine technology and two years experience in work to be performed; or equivalent combination of education and experience)	Plans, directs, and assigns duties of marine and senior technicians; assists in the planning of scientific research at sea and ashore; acts as liaison with departments in procuring, developing, designing, testing, and supervising equipment, methods, and laboratory facilities; and performs other related duties as required

This classification system together with the salary schedule should serve as a barometer for other employers.

2. Secondly, a central agency should be established to collect and disseminate information concerning marine technology curriculums in two-year colleges. The interchange of information can reasonably lead to a desirable degree of uniformity, or at least can define clarity of purpose among programs. The question of specialized accreditation should be postponed.

In summary, the classification of marine technicians is vitally important to the industrial technology as well as to the individual technician. In the Florida AAJC conference on marine technology, there was a near unanimous voice in promoting the status of the marine technician. Only one dissenting voice, that of an oceanographer, relegated the two-year educated marine technician to the status of a robot. Education is based on personal pride and achievement. One of the most persistent and anguished cries of today's world is the plea of the low-economic class for more status and a greater voice in decision making in the problems facing society. To provide the means to this end, I have stated here the following recommendations to increase his stature as a marine technician:

1. Establishment of classification and realistic pay scale by the United States Civil Service Commission.

2. Establishment of a national committee or center to collect and disseminate information about curriculums, fishery technology curriculums, and possibly, all technologies.

SURVEY IMPLICATIONS TO DETERMINE THE DEMAND FOR MARINE TECHNICIANS

5

A prime purpose of this report is to publish the findings of a survey of the present use of and potential demand for marine technicians. The results and conclusions presented are based primarily on a survey in California but, as wil. be shown below, it is believed they provide a valuable insight to the national picture.

Traditionally, vocational education has employed the occupational survey and job analysis techniques to ensure the effectiveness of a technical training program. Surveys designed to determine the needs of technicians per se are not always adequate as a means of identifying the educational services required. However, one positive effect of surveys and analyses is that we are guided, not simply by our ideas, but also by the practical needs of the industry presented in the survey. In any such survey as this which encompasses a variety of local populations and includes many factors, great care must be exercised in analyzing the data to see that appropriate statistical procedures are used and that the significant results as they apply to specific areas are properly recorded. With this in mind, the author shall attempt to present collected data in simple, concise terminology and show the relationship to conditions existing in California.

Summary of the California Survey

The marine technology survey in California took place between March 1967, and March 1968. Organizational names and addresses, both private and government related, were obtained from various sources. The majority of the listings were obtained from two national marine yearbook-directories (13; 7). The assumption was that all of these organizations were involved in producing in total or in part some marine services or products.

The following segments will highlight the information and implications of this survey.

1. *How many organizations were surveyed?*

   484 were sent questionnaires or were personally interviewed.
   152 organizations responded.
   49 responding oragnizations gave negative replies.
   103 organizations responded with statistical data on marine technicians.

2. *How many of the sample organizations (103) employ "marine technicians"?*

   Only ten organizations actually used and listed their technicians as marine or oceanographic. However, job titles are *not* the criteria for classifying marine technicians; rather, it is the training and work capabilities that determine "marine" classification. The responding companies, with the exception of a few, would *employ* a marine technician if he were educated by means of the described curriculum (but not necessarily as a "marine technician").

   Thus, the majority of the responding organizations, although involved in marine services and products, listed their technicians under other titles — engineering aides, electronic, chemical, biological, etc. Even some oceanographic organizations (e.g., Naval Undersea Warfare Center in Pasadena) do not list "marine technicians" by title, but all their technicians are "marine" in training and capabilities.

No attempt was made to determine why 332 organizations did not reply to the survey — many may have considered this survey to be troublesome. How many more did not complete the questionnaire because of vagueness surrounding the term "marine" (even though an attempt was made to clarify the term) is not known either. With this in mind, there is no doubt that regional surveys should be undertaken by local junior colleges to gain a clearer picture of the local situation.

3. *What is the demand for a trained marine technician?*

   3,922 technicians are employed by 103 organizations.

   591 is the annual turnover.

   4,015 technicians are needed within the next five years based on the current standards of employment. The majority of these technicians would work partly in marine activities and partly in other discipilnes.

4. *What is the annual salary for these technicians?*

   $7,605 is the average salary for all technicians.

   $7,965 is the average salary for technicians with a four-year baccalaureate degree.

   $7,536 is the average salary for technicians without a four-year degree.

   $3,600 is the lowest salary.

   $20,000 is the highest salary.

5. *How many technicians hold at least a four-year degree?*
   What is the demand?

   590 (15%) of the 3,922 technicians have at least a four-year degree.

   3,332 (85%) of the 3,922 technicians do not have a four-year degree.

   Thus, the major need is to establish curriculums of less than four years to train marine technicians.

   Five-Year Demand

   501 technicians with four-year degrees will be needed within five years.

   86 (15%) of 501 will be shipboard or oceanographic related.

   415 (83%) of 501 will be general technicians in support of marine work.

6. *What is meant by general (marine) technician and*
   shipboard marine technician?

   Of the 3,922 technicians

   3,709 (95%) are classified as general technicians in support of marine activities;

   213 (5%) are classified as ship-related marine technicians.

   Five-Year Demand will be 4,015 technicians

   3,584 (89%) general technicians will be needed;

   431 (11%) ship-related marine technicians will be needed.

   If organizations listed their technicians as basically *landlocked* technicians involved as engineering, chemical, electronic aides, etc.; these were classified as "general technicians" in support of marine activities, and were often called "general marine technicians" for purposes of identification.

   If organizations listed their technicians as basically ocean or ship oriented, these were classified as ship-related marine technicians. We may simplify this group by calling these individuals *oceanographic* technicians — they are likely to be sea-going technicians.

7. *Is there a need to establish a four-year baccalaureate program*
   to train marine or oceanographic technicians?

   There are 590 technicians with four-year degrees presently employed in California. 513 of these are classified as "general technicians." They are biologists, chemists, engineers, geologists, etc., with a baccalaureate degree—all working as technicians. By and large, the traditional disciplines of four-year colleges and universities can meet the demand of an additional 415 "general technicians" within the next five years for the sample organizations, or the additional 1,306 statewide demand of 261 technicians per year.

There were 77 ship-related technicians employed with a four-year degree. Some organizations, such as the University of California's Marine Physical Lab in San Diego, were fairly adamant that they only employ B.A. or B.S. technicians. Oceanographic technicians wtih degrees were generally employed by university graduate schools. With the five-year demand of 86 for the sample organizations, or the projected California statewide demand of 281 or yearly demand of 56 baccalaureate ship-related technicians, I surmise that several four-year programs in California might be sufficient to supply this demand. One or two could be located in Northern California and similiarly in Southern California, preferably the San Diego region.

8. *What is the demand for junior college two-year trained marine technicians?*

   103 organizations provided data:

   3,332 (86% of technicians employed) held no baccalaureate degree.

   3,514 technicians will be needed within the next five years (projected under present conditions).

   Of the 3,514 technicians needed within the next five years:

   3,169 (89%) are needed as general marine technicians.

   345 (11%) are needed as oceanographic technicians.

   Regional planning by junior colleges should consider very strongly the needs of their locale to prevent curriculum overemphasis in an area of small employment.

9. *What is the employability of an individual trained as a "general marine technician"?*

   A typical comment by many ocean-oriented employers was: "Given a choice between two individuals, each with an approximately equal amount of electronic training and background, I would take the technician with the marine curriculum." This is the dominant reaction of the organizations surveyed.

   Only one electronic firm in the San Francisco Bay area stated, "Your electronic-trained marine technician would not be acceptable. Although we participate in some ocean products, we do not need marine-oriented individuals." Others may have the same feeling, but the survey showed very few such firms.

   In-service training and close cooperation between the participating educational unit and local industrial organizations are vital to the successful placement of students.

   A comparison of the various regions of California is included in Appendix V. Further statistical data is available from the author.

National and California Projections

To ensure some validity in the projections of potential numbers in California and throughout the nation, the computation is based on standard statistical tables and formulae.

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1. *How many organizations in the United States produce marine services and products?*

From two national marine yearbooks, 1,660 organizations were listed as producing in part or in total marine services and products. Some of the firms were giant organizations, e.g., Westinghouse Corporation, Lockheed Space and Missile Co., etc., and very few were one-man organizations. The list is by no means complete. For example: In the two yearbooks, California leads the nation with 353 organizations. Using this and local directories, we compiled 484 as a total. The inaccuracy of our national list is further indicated by the Florida listing. The yearbooks list 43 firms, while The Florida Oceanography Council of 100 lists at least 123 organizations that potentially employ marine technicians.

UNITED STATES DISTRIBUTION OF 1,660 ORGANIZATIONS PRODUCING MARINE PRODUCTS AND SERVICES

(Listed in descending order according to number)

Western United States

STATE	No. of organizations Private	U.S. Govt.
California	340	13
Texas	40	1
Washington	20	9
Minnesota	17	—
Missouri	13	—
Louisiana	9	—
Oklahoma	7	—
Colorado	5	—
Oregon	5	—
Alaska	—	5
Iowa	4	—
Arizona	3	—
Idaho	3	—
Kansas	3	—
Nebraska	3	—
Hawaii	2	2
Utah	2	—
Arkansas	1	1
Nevada	1	—
New Mexico	1	—
Wyoming	1	—
TOTALS	480	31

Eastern United States

STATE	No. of organizations Private	U.S. Govt.
New York	228	2
Massachusetts	132	4
New Jersey	126	1
Pennsylvania	94	1
Illinois	84	1
Ohio	72	2
Connecticut	64	2
Maryland	52	10
Washington, D.C.	38	25
Florida	37	6
Michigan	27	9
Virginia	24	2
Wisconsin	21	1
Indiana	20	—
Rhode Island	14	3
N. Carolina	8	1
Delaware	5	—
New Hampshire	5	—
Georgia	4	2
Kentucky	4	—
Alabama	3	—
Mississippi	3	3
Tennessee	3	1
Maine	2	1
S. Carolina	1	—
Vermont	1	—
TOTALS	1,072	77

* *Oceanology International Yearbook/Directory 1968*, by Industrial Research, Inc., Beverley Shores, Indiana

Hydrospace Buyers' Guide 1966, Vol. 4, Data Publications, 1808 Wisconsin Ave., N.W., Washington, D.C.

2. *What is the potential employment of the 1,660 organizations in the nation and of the 484 organizations in California?*

Using 152 responses in the California survey as the sample data, the population (95%) confidence intervals for California and the nation were projected on the current base. However, if the International Decade of Oceanographic Exploration comes into being, and if some of the wartime spending were redirected toward oceanography under a peacetime budget, a significant increase in the projections could be expected. Furthermore, since the number of organizations listed is an abbreviation of the true number of organizations, it might well be assumed that the projections are conservative.

	California Projection	National Projection
Number of organizations listed	484	1,660
Number of organizations with technicians	328	1,125
Average size of technical staff	38	38
Total number of technicians employed	12,464	42,750
Technicians employed with baccalaureate degree	1,870	6,413
Technicians employed without baccalaureate degree	10,594	36,337
Annual turnover of technicians	1,882	6,455
5-year demand for technicians	12,763	43,776
5-year demand for technicians with baccalaureate degree	1,589	5,443
5-year demand for technicians with 2-year degree	11,124	38,333
5-year demand for oceanographic technicians with 2-year degree	1,123	3,852
20-year demand for oceanographic technicians with 2-year degree	4,492	15,408

The junior colleges in California should train students to fill 11,176 projected positions within the next five years, while the nation will require approximately 38,333 trained technicians for the same period of time.

3. *How do these national projections compare with other national surveys?*

In the AAJC Florida conference on marine technology, Peter C. Badgley, program director of the Gulf Universities Research Corporation at College Station, Texas, reviewed another national survey which projected the demand for marine technicians. He cited the work of Richard Geyer for the U.S. Commission on Marine Sciences, Engineering, and Resources (*Ocean Industries,* Vol. 3, No. 3, pp. 48-51).

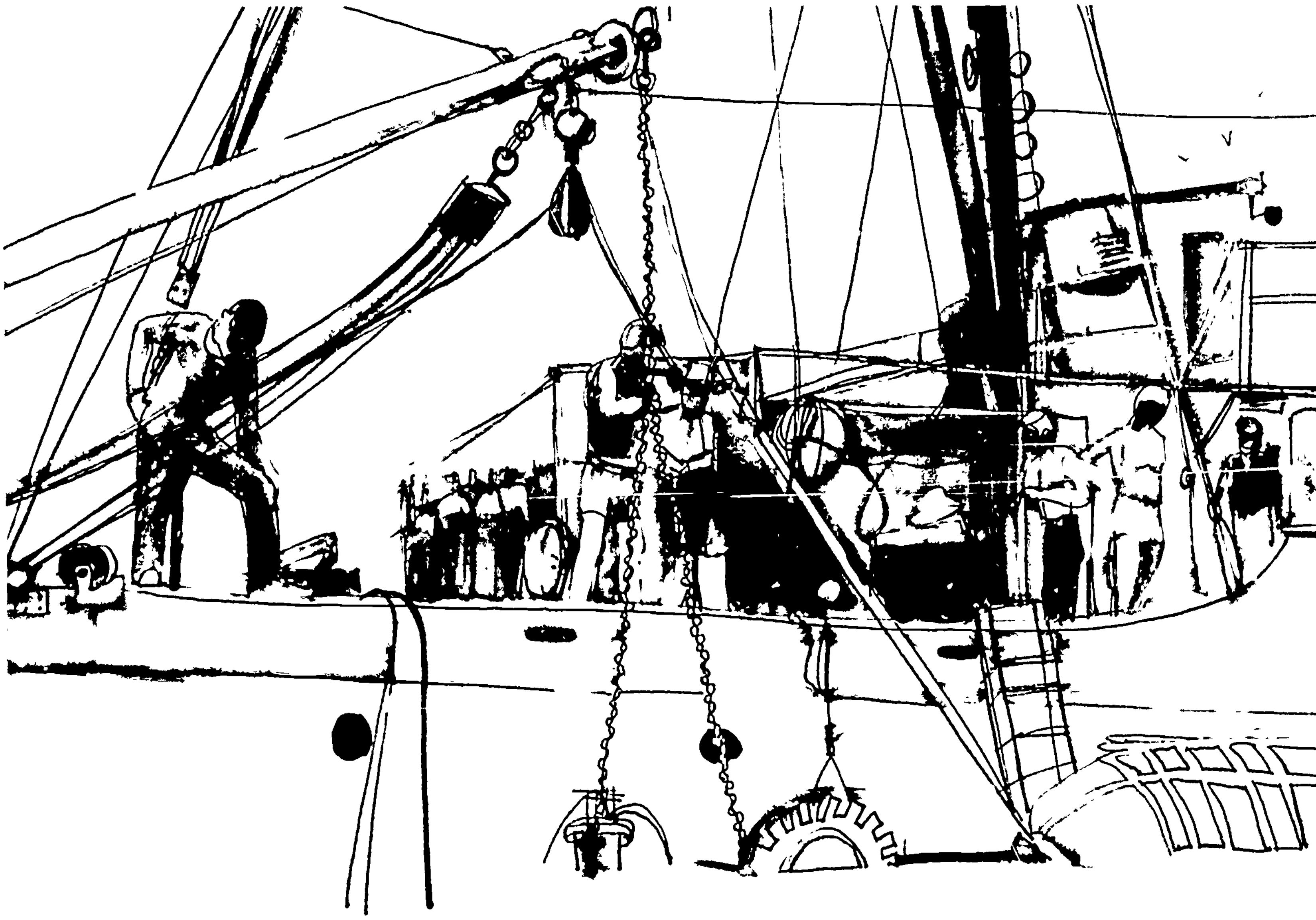
Dr. Geyer reported that the demand for professional oceanographers and ocean engineers for the next twenty years would be between 4,500-6,000.

The percentage breakdown for this projection was reported as:

Percentages of Specialization		Percentages of Degrees (twenty-year demand)
31%	Ocean Engineering	
20	Physical Oceanography	
14	Geological Oceanography	49% = Ph.D.
14	Geophysical Oceanography	48% = M.S.
9	Biological Oceanography	3% = B.S.
6	Chemical Oceanography	
6	Meteorological Oceanography	
100%		

Using the figure of 4,500-6,000 of professionals needed within the next ten years, and projecting at a ratio of 3:1, three marine technicians to one professional, Dr. Geyer reported that there will be a need of 13,000-18,000 marine technicians (without baccalaureate degree) within the next twenty years.

My projected number agrees closely with Dr. Geyer's figures above. In the United States for 1,660 organizations, the five-year demand for technicians of all kinds related to marine activities is 43,776. In the California sample 11 per cent of the total five-year demand is for marine-oceanographic technicians. Thus, 11 per cent of 43,776 is 4,815 for a national five-year demand, or 19,260 for twenty-year demand. Using the California ratio of 4:1, the five-year demand for (nonprofessional, nonbaccalaureate) technicians is 3,852 or a twenty-year demand of 15,408. This number falls approximately midway in Dr. Geyer's 13,000-18,000 estimate of twenty-year demand for marine-oceanographic technicians.



WHAT TYPE OF WORK ARE MARINE TECHNICIANS PERFORMING?

6

General Work Specifications

The question of what a marine technician specifically does was of prime concern to the delegates at the AAJC Conference. If we were to ask specific ocean managers and scientists this same question, we would receive a multiplicity of answers. Here are some brief responses from a few of these men across the nation:

Theodore Chamberlain, senior oceanographer, Ocean Science and Engineering, Inc., Washington, D. C.—

> He is a seaman who performs various technical operations aboard ship . . . his work is routine, confining, and very demanding . . . he works long hours . . . most are operators, i.e., gather intelligence concerning the ocean via some piece of equipment . . . some are involved in maintenance and repair of various gear . . . some are trained in small boat operations, diving, surveying, underwater construction, and communications . . . all are extremely valuable members of any oceanographic operation.

Harold D. Hess, physical scientist, Tiburon Marine Mineral Technology Center, Tiburon, California —

> They are now called "physical science aides" and assist in the operation of marine mineral research at sea and on shore.

J. V. Dwyer, ocean manager, Bechtel Corporation, San Francisco—

> Our marine technicians perform as engineering aides in our worldwide construction organization.

Carl H. Oppenheimer, professor of oceanography, Florida State University—

> All we like to have him do is twist dials to the place the manual says to put them.

T. K. Treadwell, Naval Oceanographic Office, Washington, D. C.—

> At sea . . . they do routine collection of data, operation of equipment . . . on shore . . . follow-up processing of the same data.

W. H. Stuart, Jr., president, Sea Research, Inc., Bartow, Florida—

> Their qualifications are the ability to work at sea, competence and responsibility in administrative techniques, safety, off-shore work, maintenance of equipment and specimens.

Donald P. Germeraad, manager of advance ocean programs, Lockheed Missiles and Space Company, Sunnyvale, California —

> Our technicians are involved in our ocean-submersible programs, which represents an entirely new horizon in marine developments.

Since the United States Government will employ many marine technicians, it might be fitting to describe one of many government agencies which will use marine technicians in their marine sciences research operations. James E. Sykes, laboratory director of the U.S. Bureau of Commercial Fisheries in St. Petersburg, Florida, lists the following areas of work:

- Electronic and oceanographic instrumentation — one of the greatest needs
- Data processing
- Fishing gear — with or without electronics
- Chemistry — physical science aides
- General laboratory — bacteriology, physiology
- Illustration — visual aids
- Biological — aquaculture and others
- Radiobiology.

On-The-Job Training

Mr. Sykes also made the observation at the AAJC conference that many of the marine technicians become proficient in the above operations with on-the-job training; he calls this latter type of training the "great equalizer."

Theodore Chamberlain supported this point of view on the providing of on-the-job training:

> There is no training program for marine technicians that is worth talking about unless it has a distinct apprenticeship application to it. The only way that you can produce technicians that will function well under the poor living conditions that we find at sea is to have this man go through a filtering process which can best be summed up by the word apprenticeship. Only therein do you filter out the type of man we are looking for in industry.

The delegates to the AAJC conference supported the concept of work experience and/or on-the-job training in conjunction with the institutional training.

Should Fisheries Be Part of Marine Technology?

Opinions were expressed at the AAJC conference that the fisheries have progressed to such a state of advancement throughout the world that an even higher degree of proficiency is now needed to ensure the fishing productivity of all nations. Some expressed concern over the declining position of the United States in fish production and asserted that a new technological study in the industry must take place soon. From the Newsletter of the American Society for Oceanography comes this news item:

> Recent data supplied by the Department of the Interior clearly indicates that the United States position in the world fish industry has declined greatly in the last nine years. In 1958 the U.S. ranked second in fish production. We slipped to third in 1959, and in 1960 we were fifth behind Japan, China, Peru, and the U.S.S.R. Now we've given fifth place to Norway. While we are sixth in production, we do not do nearly that well when it comes to eating fish. In terms of annual consumption per person, Japan leads with 54.7 lbs, followed by Sweden (47 lbs), Norway (44.5 lbs), Philippines (32.9 lbs), and China (31.3 lbs). The U.S. citizen consumes only 10.6 lbs in a year!

Some credit the decline of the U.S. to her inability to compete with other nations in the technological advances of the industry. Others feel the decline may be part of how the American views seafood. John C. Sainsbury of the University of Rhode Island views fishery technology thus:

> With the progression of the fisheries from art to science and from traditional experience to technology, the fisherman can no longer completely be self sufficient; he must be backed by technicians to maintain his investment . . . tc design and develop economically superior equipment and methods . . . by scientists to undertake the basic and applied research which in the years to come will permit the fisheries to remain competitive as a food source, and by businessmen to handle the management and control of the fisheries products.

Dr. Sainsbury feels that fisheries technology curriculum should be separated from marine technology; others at the AAJC conference agreed with him. Arthur W. Jordan of the Cape Fear Technical Institute in Wilmington, North Carolina, presented these comments to support the distinction of fisheries technology:

> I don't really think that a fisherman will become a marine technician although I think marine technology will be applied to the

> fisheries industry . . . and the fisheries technology program should be integrated with the marine technology program . . . depending on the type of (marine) program developed . . . the fisherman of the future must be an oceanographer as such . . . a marine biologist . . . understand the ecology of the sea . . . handle oceanographic instruments to find his fish . . . we should consider training fishermen at the junior college level.

Both Dr. Sainsbury and Capt. Jordan were among some that reported on the advanced fisheries technology curriculums in various foreign countries, (Japan, Russia, Norway, Canada, etc.), According to their testimony, the United States is far behind other nations in curriculum planning for industrial fisheries.

Can Women Work as Marine Technicians?

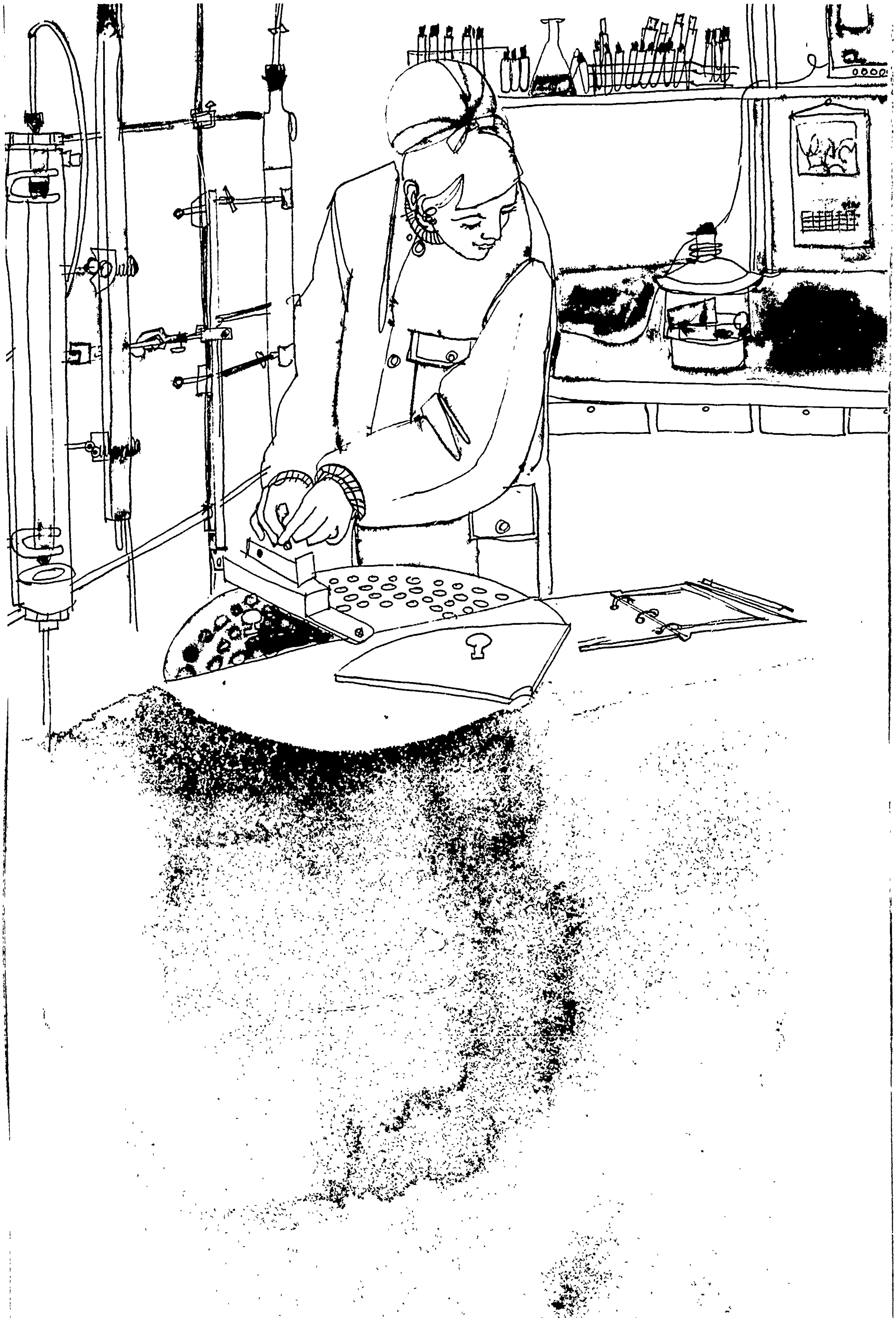
While the matter of women working as ocean-going marine technicians was not a scheduled subject at the AAJC conference, their abilities (and other qualities) were discussed by individual delegates. In general, no one interviewed knew of a female ocean-going marine technician. Some individuals remarked that they saw no reason why women should not be sea-going technicians.

Carl F. Austin, Research Geologist of the U.S. Naval Ordnance Test Station in China Lake, California, and one of the originators of the Navy's undersea "Rocksite" program ("cities" under the continental shelf), has remarked:

> The Navy projects are many and varied. Speaking for those involved with the Rocksite program we would *love* to have women technicians in our work, but we don't have any applicants who are qualified!

However, many voiced the opinion that women are numerous in technician occupations in support of marine activities. Some positions require a baccalaureate degree, while others do not. For the present, laboratory technicians seem to be the area of greatest employment, and although no statistics were compiled on the subject, there seems to be a high demand for females as technicians. One employer who was interviewed in the California statistical report on marine technicians, could not understand why more women would not flock to such an interesting and man-dominated occupation!

The pay for women would approximate the salaries for men technicians.



WHAT TYPE OF MARINE TECHNICIAN CURRICULUM IS BEST?

7

What Should Be Taught at the Junior College?

The problem of curriculum for a junior college program in marine technology was best described by Arthur W. Jordan, coordinator of marine technology of the Cape Fear Technical Institute in Wilmington, North Carolina. He stated at the AAJC conference:

> When I was at the Southern Maine Vocational Technical Institute in South Portland, Maine, we sent out questionnaires to employers all over the country, asking what skills should we teach to our marine technicians. Compiling the replies, we listed 'thousands' of items (skills) that should be taught. Trying to determine what skills to teach became a confusing task, so when I came to Cape Fear Technical Institute, we developed a basic-core curriculum. I still wonder whether this is the right step.

This question of curricular format has probably been one of the most difficult problems to solve. In each school, a marine advisory committee was probably formed to help to develop such a curriculum. In studying these curriculums and listening to the discussions of eminent men throughout the nation, there appears to be three different educational philosophies for the training of marine technicians. These are:

1. *Core or Foundational Education* — Since technologies are continuing to show rapid change and fluctuation, it would be foolish to teach specific skills that would be obsolete in a short time. Rather, the two-year college should spend its time concentrating the student's time on basic principles and foundation courses. The individual employer would enable the student to be broadly educated in marine technology and give him flexibility in moving in several employable directions upon graduation.
2. *Training of Specialized Skills* — The technology program should concentrate on teaching specific marine skills. Since there are only two short years available, the training of specific tasks and skills relating to oceanographic operations should give the student the best background for success as a marine technician. Naturally then, his employment market would be narrowed in the direction of his training. This specialized type of training may be considered highly desirable by marine employers.
3. *Educational Core and Training Skills* — The above philosophies should be blended together with foundational courses given the first year and specialized skills taught the second year. This balance of core and specialized instruction would include necessary adjustments for a changing world of technologies, and yet include the teaching of some skills necessary to the marine technical work.

Let me cite some varying opinions from men who train and hire marine technicians:

Charles R. Stephan, chairman of ocean engineering, Florida Atlantic University, Boca Raton, Florida—

> Marine technicians must understand basic principles of equipment, ocean environment, electrical and physical processes, basic mathematics, graphics, English, and laboratory techniques and procedures . . . for junior colleges, the first year should include basic subjects, practical work in the summer, and in the second year, technical subjects should be taught.

Edward Joyce, assistant director, Florida Board of Conservation, St. Petersburg, Florida —

> Basic courses . . . marine biology, math, chemistry, general physics, etc. . . . transferable college credit . . . are needed for marine technicians . . . we find our technicians want to return to college . . . dropping such courses as diesel engine mechanics, ship maintenance, navigation would help these people in later studies. For instance, in diesel mechanics . . . whenever a mechanical problem arises we take these engines to an expert. He is aware of all the recent changes in engine design and modifications. We have a guarantee on his work. Even though these people (junior college marine technology graduates) have had these courses, they are unable to utilize them because we have to go to experts. The same is true with navigation (courses). Two years of college should be a stage for further building . . . most of them (their marine technicians) stay with it (the job) only long enough to get a pot of money aside, and then go back to school for four years. So we have lost them entirely.

Theodore Chamberlain, senior oceanographer, Ocean Science and Engineering, Inc., Washington, D. C. —

> The training of marine technicians . . . should be as highly efficient as the Japanese system . . . combining abundant practical experience with highly *specialized courses* . . . courses must include adequate *sea training*.

William J. Hargis, Jr., director, Virginia Institute of Marine Science, Gloucester Point, Virginia —

> Care should be taken not to overtrain or allow overspecialization at this level (junior college), but the finished product should be able to perform satisfactorily with only a moderate amount of on-location education. Most emphasis should be placed on the technological basics such as an understanding of the methods of research and on appreciation of the need for working with care, accuracy, objectivity, reliability, awareness . . . data handling procedures should be stressed.

The consensus at the AAJC meeting was in favor of a basic core supplemented by the teaching of specialized skills.

Thorough study into the community needs of the college that serves this area seems to be a prime prerequisite as to what type of curriculum one should teach. It is important for colleges to determine where their graduates will work.

However, the education of the marine technician in the junior college should include a planned sequence of experiences that will prepare him for a cluster of job opportunities in the marine technology field. Towards this end, the California State Advisory Committee on Marine Technology suggested that the training should include:

(a) Mathematics through beginning algebra with some knowledge of trigonometry, with an emphasis on problem solving
(b) Broad knowledge of the sciences associated with marine subjects
(c) A basic understanding of the specialized methods, skills, materials and processes commonly associated with the oceans; i.e.,
  (1) Instrumentation data collecting, collating, and processing
  (2) Maintenance, repair, and operation of specialized equipment (e.g., electronic)
  (3) Drafting and graphics
  (4) Shipboard competence in basic seamanship, navigation, communication and safety procedures, and some diving and photographic experiences
(d) Sufficient depth in the fundamental communicative skills related to the general curriculum.

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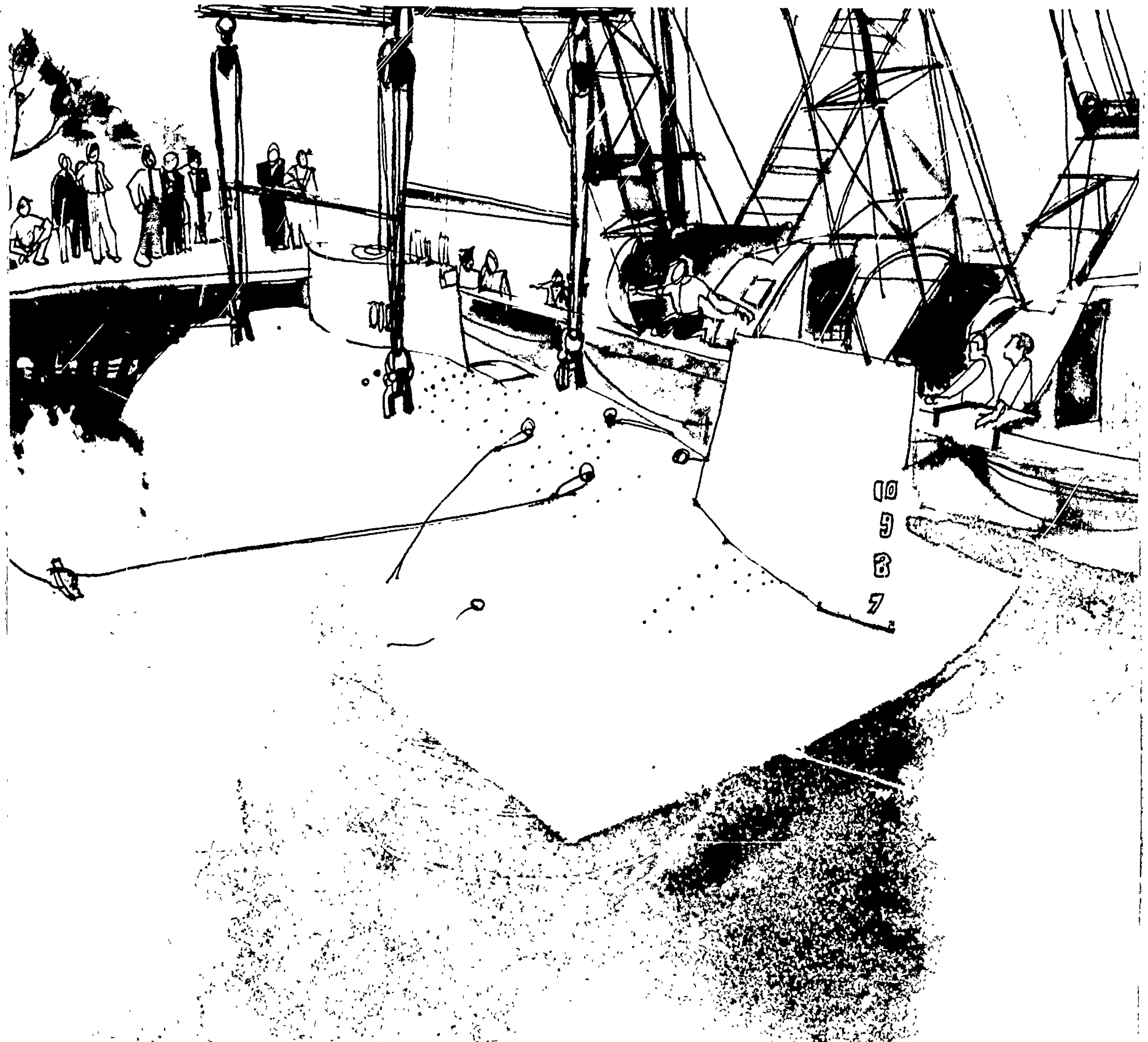
Can Technicians Be Trained at a Four-Year College?

In the California data there is indication of employment potential for baccalaureate-trained technicians, especially in those organizations associated with university-oceanographic work. The education of such marine technicians would include more mathematics and basic sciences, and a more comprehensive attainment of technological skills related to the job requirement.

Colleges and universities throughout the United States have developed oceanographic engineering and marine science curriculums to supply this manpower demand. There was no attempt in the survey to determine if B.S. employees were performing tasks as a technician of a lower classification or if they were specifically hired for jobs requiring B.S. degree. At least one California university with B.S. technicians is adamant about employing *only* baccalaureate individuals. It is recognized that salaries for baccalaureate technicians are generally higher (statewide average is $430 higher) than the salaries for two-year technicians.

Nevertheless, it is assumed that individuals generally desire to improve their economic position, and it may be profitable for a junior college to work out course agreements with senior colleges, so as to enable more determined students to transfer to a four-year technician program. The University of Rhode Island has a progressive, integrated program of two-year and four-year curriculums in fisheries technology. However, in the overall consideration of a junior college curriculum in marine technology, the student is trained to work as a technician in an area of great concern and manpower shortage after completing his two-year course of study.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WHAT JUNIOR COLLEGES ARE INVOLVED IN THE TRAINING OF MARINE TECHNICIANS? 8

California Administration and Programs

In California, the principal educational body responsible for coordinating the direction of junior college vocational-technical programs, and responsible for recommending approval for federal funding, is the Bureau of Vocational-Technical Education. The California Community Colleges, Sacramento. For further information contact: Leland P. Baldwin, chief, or William G. Gordon, consultant, at the Bureau of Vocational-Technical Education, The California Community Colleges, 721 Capitol Mall, Sacramento, California 95814.

In direct advisement to this educational bureau is the State Advisory Committee on Marine Technology. The purpose of this committee is to advise and make recommendations regarding: (a) the needs for, and the development of marine technology programs and the curriculums involved; (b) evaluation, upgrading, and modernization of continuing programs; (c) facilities and equipment required.

Since California leads the nation in the number of marine organizations, training marine technicians in the California junior colleges is quickly becoming contagious. Basic guidelines for these marine courses of study have come from surveys showing the dominant physical science technology interest of the marine-related industries; other curriculum contents have been the result of ad hoc committees. The following describes the individual programs in the state:

1. *College of the Redwoods*

An Ad Hoc Fishery Advisory Board has recommended that a Fishery and Marine Resources Technology Curriculum be set up at the College of the Redwoods for vocational training and upgrading of fishermen and seafood processors. The next probable step is to develop a practical fishery technology course of study in cooperation with the local fishing organizations. Such a curriculum should be an asset to cooperating institutions by sending their students to the College of the Redwoods for fishery training.

2. *The College of Marin, Kentfield*

The curriculum in marine technology is intended to train an electronic-instrumentation marine technician. The intention is to provide a broad foundational base to enable students to move into a variety of occupations. Each course in the program will place major emphasis on its particular marine technology. Students will graduate with a certificate and associate in science degree in marine technology. Furthermore, students in other disciplines may wish to take marine science courses to enhance their record, thus also qualifiying themselves for employment with organizations not totally involved in the marine field. The course of study begins September 1968, and is geared to train twenty or thirty students.

The sequence of courses is as follows:

First Semester: Introductory background courses

Second Semester: Specific courses in marine sciences

Summer Session: Technician training at the college's Bolinas Marine Station; opportunities are provided for the student to travel to areas of Southern California to view industrial opportunities

Third Semester: Specialized chemical and electronic instrumentation as associated with the problems of marine industry

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Fourth Semester: Further specialization in physical science, computers, and instrumentation; in-service seminar to visit local employers is also scheduled this semester. Cooperation and in-service training on oceanographic vessels and in industries are vital parts of the program.

3. *Santa Barbara City College*

A large number of applications has already been received to start in September 1968, with the curriculum leading to an associate in science degree in marine diving technology. Planned cooperation with two or three adjacent junior colleges is being considered along with local industrial organizations. An advisory committee has also recommended training options towards other fields of marine technology.

The purpose of the program is to meet the growing needs of industries currently engaged in oceanographic research and underwater construction in this area. The area is rich in offshore oil exploration and academic research is being conducted by the University of California at Santa Barbara and General Motors Research Laboratories.

The student must become a skilled diver capable of working with all types of diving gear under a wide range of conditions, and as part of an integral team. To achieve these ends, three types of courses will be offered: (a) a basic understanding of the physical environment in which he will be working; (b) series of courses designed to develop basic skills required of the diving technicians; (c) general education courses designed to increase the student's knowledge and communicative ability.

4. *Los Angeles Trade-Technical College*

This technical college, located in the heart of Los Angeles, has developed a certificate curriculum for September 1968. The first year contains a basic core of instruction while the second year specializes in marine chemistry, navigation, microbiology, scuba, electronics, pollution, and marine ecology.

The college has a plan for in-service training of its students, and soon hopes to add a summer employment program. As with other programs, the school will cooperate with nearby university marine programs for its oceanographic opportunities.

5. *Fullerton Junior College*

Fullerton Junior College has had a large enrollment in its program for the oceanographic technician which has been under way since September 1967. Graduates will receive an associate of arts degree.

The program consists of courses which will train students in the fundamentals of oceanographic technology, so that the students will have a broad knowledge which can be applied to many specific job responsibilities. The first year offers introductory marine science courses while the second year emphasizes navigation and ocean instrumentation materials and analyses.

Each student will be expected to participate in an on-the-job training program during the summer between the first and second years of the program. This summer job will consist of work in a laboratory, a field station, or on board a ship where students will have an opportunity to observe as well as to participate in the work.

Through its advisory board, regional cooperation is being planned with industries of the area as well as with other interested junior colleges, universities, and state colleges. The Port of Los Angeles is a large growing development in shipping. The manpower requirement of the area is large and the field is basically untapped.

6. *Orange Coast College*

Located on the coast adjacent to Newport Beach and Harbor, the college is planning to initiate its A.S. degree marine technician training program in September of 1968. The course is designed for about twenty students per year.

Its advisory committee has developed a first-year core program of marine sciences designed to provide a basic fundamental background in marine technology. The second-year program tentatively offers the student one or more options in keeping with his major interest and potentials. These options will train a marine laboratory technician or a marine construction technician.

Planning is being undertaken with other junior colleges and with the University of California at Irvine.

7. *San Diego City College*

The program in marine technology began on September 1967, and will grant to its students an associate in science degree at the completion of the program. The marine technician program is designed to prepare the student for employment as an aquatic technician, oceanographic and scientific technician, ocean-engineering technician, or marine resources aide.

The curriculum is based on a core of marine technology courses dealing with general oceanography, marine construction, equipment and laboratory operations, marine resources, communications, and seamanship and sea engineering. General education courses complete the requirements for the A.S. degree.

Since this area shows a predominance of ship-related or oceanographic technicians, the curriculum of San Diego City College appears to be in line with the occupational needs of the community.

The area abounds with ocean organizations and colleges, in particular, the University of California's Scripps Institute of Oceanography.

8. *Southwestern College, San Diego*

A unique marine technology program is being planned here to start September 1968. Under its advisory committee, an aquatechnician program has been proposed, whereby the student will be trained with specific knowledge in oceanography and engineering, and will receive instruction in manipulative and communication skills.

The two-year program will lead to an associate in arts or science degree. Three basic blocks of courses are involved in the curriculum. These are:

Environment:	field techniques, seamanship, instrumentations
Resources:	fisheries, mining, petroleum, coasts
Operations:	construction, warfare, commerce, machinery, office techniques, communications, data handling

Cooperative planning with local universities and colleges has taken place, along with such industrial organizations as the Lockheed Ocean Laboratory in San Diego.

Outline of Other Marine Technology Programs

Although an attempt has been made to cover all existing and newly proposed programs, some will inadvertently be omitted due to lack of information.

1. *Clatsop Community College, Astoria, Oregon*

Type of Program: marine technology (inaugurated September 1965)

A two-year curriculum; graduates will receive an associate degree in marine technology. Students may also earn an associate degree in oceanographic technology.

Main emphasis of the course: A two-year program designed to train men and women to assist scientific ocean exploration and research teams as laboratory technicians, both ashore and aboard ship. To assist in its training, the school has a TRAINER I, a 24-foot motor launch, and through the National Science Foundation, their students are guaranteed twenty days a year on Oregon State University's 187-foot research vessel, YAQUINA. Employment needs were determined by surveying 500 prospective employers and data was collected from 187 of these national organizations.

Purpose of the Program:

a. A thorough knowledge of the techniques of gathering, recording, and processing scientific data at sea
b. A command of the basic principles of oceanography
c. A familiarity with the problems currently under consideration by oceanographers
d. A firm background in seamanship, including the handling and maintenance of vessels through the 65-foot class.
e. An alternative for students who do not adapt to work aboard vessels at sea — training for work ashore in support of oceanographic research and development
f. A broad base of supportive courses:
   (1) basic physical sciences
   (2) marine biology
   (3) mathematics (through trigonometry)
   (4) communication skills
   (5) technical report writing.

2. *Peninsula College, Port Angeles, Washington*

Type of Program: fisheries technician program (inaugurated September 1964)

Purpose of the program: A two-year vocational-technical program to prepare students for the following positions in the Washington State Department of Fisheries:

Scientific aide 1: (Washington State Fisheries Dept.) Performs variety of skilled and semiskilled laboratory and field work to facilitate fish research and management

Scientific aide 2: Same as scientific aide 1 except requiring ability to carry out assignments without direct supervision. (Upon completion of the fisheries program and passing an oral examination, graduates are usually offered a scientific aide 2 rating)

Hatchery assistant: (state and federal) Performs variety of semiskilled manual duties at state or federal fish hatcheries, and assists in technical work

Biological aide: (federal) Similar to scientific aide 1.

Facilities: The fisheries complex consists of a lecture room, laboratories, museum, and prep and storage areas. Concrete hatchery ponds are provided to raise thousands of fish eggs. A 28-foot boat is available for training as well as experiences on federal and university vessels.

3. *Shoreline Community College, Seattle, Washington*

   Type of programs: marine biology technician
   oceanography technician (inaugurated September 1967)

   Purpose of the programs: To train marine technicians who can be assistants in scientific research and related government and industrial work.

   Marine biology technician course description: Fundamentals provided in marine biology, electronics, chemistry, physics, math, speech, English, report writing, scuba diving, seamanship, and data handling. Students will learn how to make simple electronic repairs, prepare chemical solutions, prepare tissues, use photomicrography, and operate instruments such as spectrophotometers, fluorometers, conductometers, etc.

   Oceanography technician course descripition: Fundamentals provided in oceanography, geology, applied mathematics, physics, surveying, electronics, report writing, statistics, scuba diving, oceanographic instrumentation, and on-the-job training at sea for three months. Students will learn how to operate water samplers, covers, bottom grabs, trowels, plankton devices, with analyzers, bathythermographs, radar, loran, shoran, and other oceanographic instruments.

   Training facilities: Plans call for a salt water laboratory to be established in two years. The college also has about fourteen vessels at its disposal for technician training.

4. *Southern Maine Vocational Technical Institute, South Portland, Maine*

   Type of program: marine technology — a nondegree program; a diploma is presented upon completion of the course

   Purpose of the program: The course of study is designed to train men for various types of employment in the ocean industries, providing both practical and technical training

   Facilities: Onshore facilities consist of a marine industrial engineering building, a deck shop, and a marine biology laboratory building. Close by are docking facilities to accommodate the nautical school ship, AQUALAB, a 138-foot oceanographic training ship. Approximately forty days per school year are spent at sea aboard training vessels, providing for practical ship operation and the development of technical skills.

   The school has cooperative programs with various governmental agencies in collecting and recording shipboard and onshore information.

   Job opportunities are located with the fishing industries and government agencies. At present about ten marine technicians trained at the technical institute are employed by the U.S. Navy ocean program at Pt. Hueneme, California. To enhance its marine technology curriculum in conformity with the requirements of industry, the institute is conducting a national survey of ocean-related organizations. The survey will contain an up-to-date job analysis and information about opportunities for marine technician graduates.

5. *University of Rhode Island, Kingston, Rhode Island*

   Type of program: commercial fisheries technology (inaugurated September 1967)

Degree offered: associate degree

Purpose of the program: To offer a technical program aimed to serve and provide students with a thorough background in Commercial Fisheries so that they may be adequately prepared for the industrial work.

The University of Rhode Island is among the first in the United States to establish a two-year associate degree program in Commercial Fisheries as part of its baccalaureate and graduate curriculums in education. The overall combinations of the education in this institution might be seen in three levels: technical level, undergraduate level, graduate level.

Students desiring to enter the technical level of the commercial fisheries program will undergo a series of counseling evaluations to determine their needs and desires. The track of technical students might be illustrated as such:

First Year: All students enter into a common first year of basic education — communications, physics, math, economics, business, and introductory courses in fisheries and practical work

(In-service training is provided students during the summer months)

Second Year: Students desiring technical-level courses would proceed on a different stream of basic education and applied work, while others desiring technologies along an academic approach would proceed along studies of a full four-year path

Third and Fourth Years: Provides integrated course opportunities for students moving ahead in their fisheries studies.

Much sea-going experience would be provided the students to allow them to choose future options of fisheries courses.

In summary, the university is uniquely providing educational opportunities for all its students under a common roof.

6. *Suffolk County Community College, Seldon, Long Island, New York*

Type of program: marine technology

Degree offered: associate in applied science

Purpose of the program: To provide qualified high school graduates with two years of coordinated technical and general education courses at the college level in order to enable them to function as technicians in marine and allied industries.

One major emphasis of the program is its study of the shellfish industries that dot the shorelines of Long Island Sound and the Great South Bay.

The college offers in-service training by paying students who wish to work along with university scientists. Ecological shellfish sampling and the use of computerized data are part of their training techniques.

7. *Cape Fear Technical Institute, Wilmington, North Carolina*

Type of program: marine technology (inaugurated September 1964)

Degree offered: associate in applied science in marine technology

Purpose of the program: A two-year program to train men in the necessary skills for the various marine industries—provides for both technical studies in the classroom and practical experience at sea.

This successful East Coast curriculum began in 1964 with 12 students. The class of 1967 numbered 21, and an expanded enrollment of 65 students is expected in September of 1968. The Cape Fear Technical Institute is able to train 150 students in the marine technology program.

Facilities: The school maintains a fleet of vessels for training, including the 185-foot school ship, ADVANCE II. This ship is probably one of the best-equipped oceanographic vessels of any educational institution, with a capacity for accommodating at sea up to 70 students and instructors. Future plans call for a more intense, rotational work-instruction program for students at sea and in the school labs.

There are three well-equipped laboratories at the Cape Fear Technical Institute, and projected plans call for expansion of its aquarium and laboratory buildings.

8. *Miami-Dade Junior College, Miami, Florida*

   Three proposed programs in marine technology: marine survey technician, ocean engineering technician, marine electronics technicians
   Degree offered: associate in science degree

   The three proposed programs for the Miami-Dade Junior College Technical, Vocational and Semiprofessional Studies Department were developed in conjunction with W. Bruce Johnson, oceanographic coordinator, Florida Commission on Marine Science and Technology. Target for the starting dates of these programs is September 1968.

Course Recommendations: Subject Areas	Marine Survey Technician	Ocean Engineer Technician	Marine Electronic Technician
General oceanography	X	X	X
Intro. to marine geology	X	X	
Intro. to geophysics	X		
Physics	X	X	X
Chemistry	X		
Mathematics	X	X	X
Slide rule	X		X
Graph plotting	X		X
Electronic drafting			X
English	X	X	X
Social science	X	X	X
Physical education	X	X	X

Thus, there were eight programs in operation throughout the United States during the school year of 1967-68, while at least eleven additional programs are being planned for 1968-69 or later. Some of the existing programs are highly successful in student enrollment, while others have very few students who complete the two-year program. In each school, there were more jobs available than there were graduates of the program.

9 IS THE FINANCING OF MARINE TECHNOLOGY PROGRAMS EASY?

A crucial question for most colleges and universities is what will the costs be and where will the money come from? Statistics concerning the costs of marine technology programs are needed. Even more important is the question of demand — do we really need a marine technology program? All too often the step is taken because of the popular trend. Colleges and universities detest being achromatic or second class when it comes to having new programs; and psychology is being carefully analyzed by the powers that control the dollars. The following is an up-to-date synopsis of financial support for marine technology:

Robert B. Abel, director of the National Science Foundation Sea Grant Program, stated in an address to the Governor's Advisory Commission on Ocean Resources (18;44):

> Ever since the program's (Sea Grant) inception, I have been deluged with demands highlighting above all else, the desperate need for ocean technicians . . . This is a prime mission to which we in the Sea Grant Program are already addressing ourselves. We hopefully predict significant output of technicians in about three or four years.

The Sea Grant Program is already funding marine technology curriculums at the junior college level. There is reason for general optimism for continuing support. Harold L. Goodwin, Planning Officer of Sea Grant Programs, stated at the American Junior College Association conference on marine technology in Florida:

> Sea Grant will not support schools that do not have a base from which to build, which means that schools must show a regional need . . . The schools should determine this need. The college would have to show conclusively that a market existed for technicians both now and in the future to warrant funding. By the third year, schools receiving the Grant must be self-supporting in their own programs.

One other comment that might be noteworthy to pass on to participating schools is that Mr. Goodwin has stated that applications have come into his office with gross inadequacies in budgetary listings and justifications of supplies and equipment.

The major vocational education statutes available for additional support in this direction are:

(1) The Smith-Hughes Act of 1917 which provides money annually for promotion of vocational programs
(2) The George-Barden Act of 1946 . . . for vocational education
(3) The Fishery Training Amendment of 1956 . . . for fishery personnel
(4) The George-Barden Title III (Title VIII of the National Defense Education Act of 1958) . . . for technician training
(5) The Vocational Education Act of 1963 . . . assistance for occupational training.

To prepare students for a two-year training program in marine technology requires much hard labor. The many variables of student problems present a greater challenge to college administrators than those associated with students of gifted academic reasoning. Our middle class culture has pressured the majority of our student population to press on for a baccalaureate degree with the often mistaken belief that in the end, the education earned will result in a pot-of-gold reward by employment on the management level. The junior college program in marine technology is working at a level lower than the B.A., and the insurance of success for the two-year students must surely be more than a whisper of "counseling" advice.

Colleges should carefully assess their community position before undertaking an expensive marine technology program. Some questions for a self-test should include:

1. Is there a demand in your community for marine technicians, or will you need to "farm" the student out to other areas or states?
2. Does your community have a reasonable prospective student population in marine technology?
3. Is your school close to a marine environment?
4. Can the students obtain in-service training? Can sea training be provided?
5. Are there sufficient teachers available who have the technical experience as well as the academic background to ensure the quality of the program?
6. Is the school, with its students, teachers, counselors, and administrators, sympathetic and realistic towards vocational-technical educational goals?
7. Can a representative advisory committee be set up to help evaluate the program each year?
8. Can regional planning be initiated with other colleges and with private organizations?
9. Finally, can your school eventually assume full financial responsibility?

These are the general questions that the marine technology advisory committees should investigate in a *real* sense — with a vision that is not clouded with the grandeur of ocean dreams; but filled with practical reality because we are working with students, many of whom previously have not had much vocational hope.

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10 CONCLUSION

The following general points and recommendations have appeared in this report:

1. Technical education in our middle class junior college cultural system ranks second behind the popularity of striving for a transfer (B.A.) program.
2. It would be advantageous for the United States Civil Service and other organizations concerned with the employment of technical personnel to establish appropriate classifications and pay scales for the marine technician.

3. Approximately one third of junior college students continue their education to try to earn a B.A. degree. Two-thirds either do not complete the two years or terminate their education with occupational employment.
4. The occupation of a marine technician is difficult to define; however, in the broadest sense, this report defines the marine technician as one whose education and experience qualify him to work in the area of marine technology which requires the application of technical knowledge, methods, and skills. There are many subsets of marine technicians working in various technological disciplines — a sea-going technician is but one of these.
5. Based on a ratio of three technicians to one professional, an estimated national demand was derived as approximately 15,000 oceanographic technicians in twenty years and a projected five-year demand of 38,000 technicians needed in support of marine activities.
6. The marine technician may be considered a "Jack-of-all trades," working in the areas of marine oil and mining, oceanography, scientific research, fisheries technologies, hardware technologies, and aquaculture.
7. Marine-related laboratories provide attractive opportunities for women technicians.
8. The junior college curriculum favored most in the training of marine technicians is the one providing basic foundational science courses, followed by specialized training. In-service training, particularly at sea, seems to be important and may be obtained in part during summers. The technician is trained to fill the work span between a professional and trade craftsman.

   Since some large universities and government organizations employ only baccalaureate technicians, there appears to be some need for training this grade of marine technicians.
9. Throughout the United States, there are nine junior colleges with marine technology programs underway, and there are a known eleven additional programs to be underway by the school year of 1968-69. Thus, there are at least twenty junior colleges that will be involved in marine technology by the early 1970's. Ten of these programs are in California, indicating that this state leads the nation in the number of organizations involved in marine activities.
10. The financing of marine technology curriculums appears to be a major factor in limiting the number of programs. NSF Sea Grant Programs have repeatedly said that regional planning and clear definition of employable needs must be spelled out before funding is granted.
11. In considering establishing a program, schools should inspect carefully the demand for marine technicians in their community, the cultural patterns and attitudes of the community; the proximity of marine facilities; the availability of experienced staff; and the ability to finance the program within a regional area.
12. Finally, a boom in oceanography may be coming and the magnitude of its scale will fluctuate with political and economic conditions in the world. The goal of American junior colleges is to be sensitive to the needs of the marine community and to respond by providing occupational training opportunities to qualified students.

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Illustrations made on photographs supplied by Gordon L. Chan.

APPENDIX
1

APPENDIX
2

THE AMERICAN ASSOCIATION OF JUNIOR COLLEGES AND THE SEA GRANT PROGRAM OF THE NATIONAL SCIENCE FOUNDATION

A PLANNING CONFERENCE
"JUNIOR COLLEGE INVOLVEMENT IN THE TRAINING OF MARINE TECHNICIANS"

Cooperating Organizations:

FLORIDA INSTITUTE OF OCEANOGRAPHY
FLORIDA DEVELOPMENT COMMISSION
ST. PETERSBURG JUNIOR COLLEGE

MARCH 17, 18, 19, 20, 1968

PORT O'CALL INN ST. PETERSBURG, FLORIDA

"JUNIOR COLLEGE INVOLVEMENT IN THE TRAINING OF MARINE TECHNICIANS"

PROGRAM

MARCH 17 **SUNDAY**	1:00 - 3:00 P.M.	Registration
	3.30 P.M.	Planning Session — Staff, Speakers, Discussion Leaders
	5:30 P.M.	Reception and Dinner Welcome: Dr. Michael M. Bennett, President, St. Petersburg Junior College
	8:00 P.M.	"Purpose and Procedures of Conference"— Dr. Lewis R. Fibel, Specialist in Occupational Education, AAJC
		"An Overview of Oceanography and Marine Technology" Captain Charles R. Stephan (USN — Retired) Department of Ocean Engineering, Florida Atlantic University, Boca Raton, Florida
MARCH 18 **MONDAY**	8:45 A.M.	"Philosophy of Today's Program" Dr. Robert E. Smith, Director Florida Institute of Oceanography, St. Petersburg, Florida
	9:00 A.M.	*Introduction*
		"A Working Definition of What the Qualifications of a Marine Technician Should and/or Should Not Be." Captain T. K. Treadwell, Deputy Oceanographer of the Navy, Washington, D.C.
	9:10 A.M.	*Basic Research Session* "Marine Technician Manpower Requirements in Basic Research." Dr. Peter C. Badgley, Program Director, Gulf Universities Research Corporation, College Station, Texas
	9:20 A.M.	"The Involvement of Junior Colleges in the Training of Marine Technicians as Proposed by a Government Marine Sciences Research Organization." Mr. James E. Sykes, Director, U.S. Bureau of Commercial Fisheries Biological Laboratory, St. Petersburg Beach, Florida

9:40 A.M. "The Involvement of Junior Colleges in the Training of Marine Technicians as Proposed by an Academic Marine Sciences Research Institute."
Dr. William Hargis, Director,
Virginia Institute of Marine Sciences,
Gloucester Point, Virginia

10:00 A.M. Speakers Questioned by Staff Member of College presently Engaged in the Training of Marine Technicians.
Mr. Walter L. Smith,
Associate Professor of Marine Technology,
Suffolk County Community College,
Seldon, Long Island, New York

10:30 A.M. Panel Discussion: Questions and statements from the floor with regard to "How and Why Should Junior Colleges be involved in the Training of Marine Technicians for Basic Research; What Types of Curricula Should Junior Colleges Offer?"
Moderator: Dr. Peter C. Badgley
Panelists: Mr. James E. Sykes
Dr. William Hargis
Mr. Walter L. Smith
Capt. T. K. Treadwell

1:00 P.M. *Industrial Applications Session*

"Marine Technician Manpower Requirements in Industrial Applications."
Mr. James S. Cullison, II, Manager,
Marine Science and Technology,
Florida Development Commission,
Tallahassee, Florida

1:10 P.M. *Biological Applications*

"Marine Technicians Required by Commercial Aquaculture Industries; Qualifications, and Numbers of Individuals Proposed."

1:30 P.M. "The Involvement of Educational Institutions in Preparing Individuals for Employment as Marine Technicians with Commercial Aquaculture Industries."
Dr. Carl H. Oppenheimer, Director,
Department of Oceanography,
Florida State University,
Tallahassee, Florida

1:50 P.M. *Physical Applications*

"Marine Technicians Required by Primary Marine Science Industries; Qualifications, and Numbers, of Individuals Proposed."
Dr. Theodore Chamberlain,
Senior Oceanographer,
Ocean Science & Engineering, Inc.
Washington, D.C.

2:10 P.M.	"The Involvement of Educational Institutions in the Preparation of Individuals for Employment as Marine Technicians with Primary Marine Science Industries." Captain Charles P. Stephan (USN — Retired) Chairman, Department of Ocean Engineering, Florida Atlantic University, Boca Raton, Florida
2:30 P.M.	"Marine Technicians Requirea by Secondary Marine Science Industries; Qualifications and Numbers, of Individuals Proposed." Mr. W. H. Stuart, President, Sea Research and Development, Bartow, Florida
2:50 P.M.	"The Involvement of Educational Institutions in the Preparation of Individuals for Employment as Marine Technicians with Secondary Marine Science Industries." Dr. Jack Morelock, Head, Department of Oceanography, Florida Institute of Technology, Melbourne, Florida
3:10 P.M.	Speakers Questioned by Staff Member of an Institute Presently Engaged in the Training of Marine Technicians. Captain Arthur W. Jordon, Cape Fear Technical Institute, Wilmington, North Carolina
3:30 P.M.	Panel Discussion: Questions and statements from the floor with regard to "How and Why Should Junior Colleges Be Involved in the Training of Marine Technicians for Industrial Applications: What Types of Curricula Should Junior Colleges Offer?

Moderator: Mr. James S. Cullison, II
Panelists: Dr. Carl Oppenheimer
Dr. Theodore Chamberlain
Captain Charles P. Stephan
Dr. Jack Morelock
Captain Arthur W. Jordon
Captain T. K. Treadwell

MARCH 19
TUESDAY

8:30 A.M.	Leave Port O'Call via charter bus to Florida Institute of Oceanography
9:00 A.M.	Welcome and Orientation — Dr. Robert E. Smith, Director, Florida Institute of Oceanography
9:15 A.M.	Group A — Aboard Ship in Gulf Leader — Mr. Edward Joyce, Assistant Director, Florida Board of Conservation

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	9:15 A.M.	Group B — Tour of the Marine Sciences Institute of the University of South Florida and a tour of Florida Board of Conservation Facilities. Leader — Dr. Harold Humm, Director, Marine Science Institute, USF
	10:30 A.M.	Group B — Aboard Ship
		Group A — Tour of Facilities
	11:45 A.M.	Leave Florida Institute of Oceanography via charter bus to Aunt Hatties Restaurant
	1:15 P.M.	Return to Florida Institute of Oceanography via charter bus
	1:30 P.M.	Curriculum Development — Dr. William J. Stallard, President, South Florida Junior College, Avon Park, Florida
	2:00 P.M.	Small discussion groups — Development of Curriculum Guidelines
	4:00 P.M.	Leave Florida Institute of Oceanography via charter bus to Bureau of Commercial Fisheries
	4:30 P.M.	Welcome and Tour — Mr. James Sykes, Director, Bureau of Commercial Fisheries
	5:30 P.M.	Return to Port O'Call via charter bus
	7:00 P.M.	Banquet
	8:00 P.M.	The Role of the National Science Foundation; Office of Sea Grant Programs. Dr. Harold J. Goodwin, Planning Officer
	9:00 P.M.	Conference Summary and Proposals for Further Action — Dr. Lewis R. Fibel, Specialist in Occupational Education, AAJC
MARCH 20 WEDNESDAY	9:00 A.M.	Meeting of Staff, Speakers, Discussion Leaders and Writers
	12:00 Noon	Adjournment

APPENDIX 3

PLANNING AMERICAN JUNIOR COLLEGE INVOLVEMENT IN THE TRAINING OF MARINE TECHNICIANS

St. Petersburg, Florida, Port-O-Call Inn, March 17-20, 1968

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COMPARISON OF THE CALIFORNIA REGIONS

The survey statistically divided the state into several regions. Four basic regions were established by the listing of 484 organizations and the statistical response of the 103 replying firms. These four regions are:

No. of org. surveyed	Region	No. of org. providing data
170	San Francisco Greater Bay Area	54
18	Santa Barbara-Ventura Area	3
247	Los Angeles Basin Area	34
49	San Diego Area	12
484		103

The State Governor's Advisory Committee on Ocean Resources in the 1966 GACOR Report listed 6 regions for higher educational planning. The above four were listed along with the Humboldt and Monterey-Santa Cruz areas.

What did the survey show concerning the Humboldt and Monterey-Santa Cruz regions?

Of the 484 surveyed organizations from various directories on marine services and products, none were listed in the Humboldt area. In the Monterey-Santa Cruz area, only 7 were listed and 4 responded. The number here was so small that these organizations were grouped into the San Jose district of the San Francisco Greater Bay Area. However, for the convenience of those schools in the Monterey and Santa Cruz region, I have isolated the data from the San Jose district.

Where did the Humboldt Area data come from?

The data presented here was taken from a survey report titled — *A Survey of Need for a Fishery and Marine Resources Technology Program at College of the Redwoods,* by J. Gary Smith, February, 1968. Copies of this report may be obtained from: Dr. Elssworth Briggs, Vice President, College of the Redwoods, Eureka, California 95501.

This region abounds with commercial fisheries and their report illustrated an annual demand for about 24 commercial fishermen, and a two-year demand of 366 seasonal seafood processors. Humboldt State College with a B.S. degree program in oceanography will lend support to the College of the Redwoods in its technology program. The establishment of such a Marine Fishery Technology curriculum at the College of the Redwoods seems to be a wise investment for the state of California.

What type of comparisons can be observed between the four basic areas?

The San Francisco Greater Bay area, Santa Barbara-Ventura area, and the Los Angeles Basin area were very similar in statistical percentages. The San Diego area deviated from the other three as shown in the percentage table below:

	Technicians Presently Employed					Technicians 5-year Demand			
Area or Region	Org. with tech	with degree	w/out degree	Gen. tech	Ship tech	w/out degree	with degree	Gen. tech	Ship tech
San Francisco	54	14%	86%	98%	2%	13%	87%	95%	5%
Santa Bar.-Ven.	3	12%	88%	100%	0%	11%	89%	100%	0%
Los Angeles	34	15%	85%	94%	6%	10%	90%	86%	14%
San Diego	12	38%	62%	28%	72%	21%	79%	28%	72%

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The Santa Barbara Area can be overlooked here because of the small number of participating organizations (3) in this survey. The survey may illustrate its incomplete coverage by this small number. Notice how similar San Francisco and Los Angeles percentages are in all categories. The significant difference is the San Diego area. There appears to be in San Diego a higher percentage of degreed technicians (38%) and ship-related technicians (72%). The obvious reason for the higher percentages seems to point to the presence of the University of California's Scripps Institution of Oceanography, the Bureau of Commercial Fisheries at Scripps, and the U.S. Naval organizations. The suggested curriculums in this area may then be slanted more towards ship or oceanographic technician training than those of the other northern regions. The same conclusion of greater degreed ship technicians may also be observed in the Monterey Area.

Again, one must assume that the statistical implications here may present false impressions due to the small number of participating-responding organizations. An example would be the Santa Barbara-Ventura Area. Of 49 surveyed organizations, only 4 responded, thus making the data of this area open to biased interpretations because of the small sample.

APPENDIX 6

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